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Energy Opportunities

LIGHTING FOR MORE MILK

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INTRODUCTION

This Factsheet discusses opportunities for increasing milk production by adjusting the lighting in dairy barns. It explains some of the practical challenges of controlling long-day and short-day photoperiods for milking and dry cows.

LONG-DAY PHOTOPERIOD FOR MILKING COWS

A well-lit barn improves operator efficiency, comfort and safety (see Figure 1). In addition, research has shown that milk production can be increased by regulating the dairy cow's exposure to light. Milking cows exposed to 16 to 18 hours of light with a brightness of 15 to 20 footcandles followed by 6 to 8 hours of darkness have consistently increased their milk yield by 8%–10%. This lighting pattern is often referred to as a long-day photoperiod (LDPP).

Figure 1. A well-lit barn improves efficiency, comfort and safety.

DEFINITION: **Brightness** is a measure of the amount of light striking a surface. It is measured in units of *footcandles*. One footcandle is defined as 1 lumen of light falling on 1 square foot. The metric equivalent of a footcandle (fc) is a *lux* (lumen per square metre). 1 footcandle = 10.76 lux.

WHY A LONG-DAY PHOTOPERIOD INCREASES MILK PRODUCTION

Light hitting the eye of the cow activates certain hormones. The first response is to send a signal to suppress the release of the hormone melatonin. Cows use the daily pattern of melatonin to set their internal clock, influencing the secretion of a number of other hormones, including insulin-like growth factor-1 (IGF-1). Increases in IGF-1 influence the mammary gland to increase milk production. So increasing the hours of daylight decreases the amount of melatonin in the cow, which in turn increases the production of IGF-1, which increases milk production.

OTHER FACTORS TO CONSIDER

Milk yield responds to an increased photoperiod in about 2–4 weeks. The response is gradual, but consistent and repeatable. In general, studies show that increases in milk production can range from 5%–16%, but are most consistently in the 8%–10% range.

Cows exposed to long days while lactating consume more feed than do cows exposed to a natural photoperiod. Cows eat more *because* they are producing more milk — they do not produce more milk because they are eating more. In summary, they produce more milk and then consume more feed to meet the increased demand for energy to make the milk.

Photoperiod does not affect the protein or solid content of milk. It causes a slight decrease in fat content, but the increase in milk yield more than compensates for the effect on fat and the cost of the increased feed intake.

However, there is no benefit to providing 24 hours of continuous light. Without a period of darkness, cows can't determine the length of the day, which then causes them to lose their ability to respond to extra lighting. Experience shows that 6–8 hours of uninterrupted darkness each day are required for cows to detect and respond to the lengthened photoperiod.

A common misconception is that cows require a low level of illumination (night light) in order to find feed and water during darkness. This is not true, as cows can find their way around in the dark. However, some light may be necessary for management purposes. Dim red lights don't appear to affect the cow's perception of darkness. Low-intensity red lighting (7.5-W bulbs) mounted 6–9 m (20–30 ft) apart and 3 m (10 ft) above the floor provides adequate lighting for observing cows without upsetting the photoperiod response.

Light levels should be uniform throughout the barn, or at least anywhere the cow can see light (see Figure 2). Putting lights over the feed alley limits the exposure to and effectiveness of extra lighting.

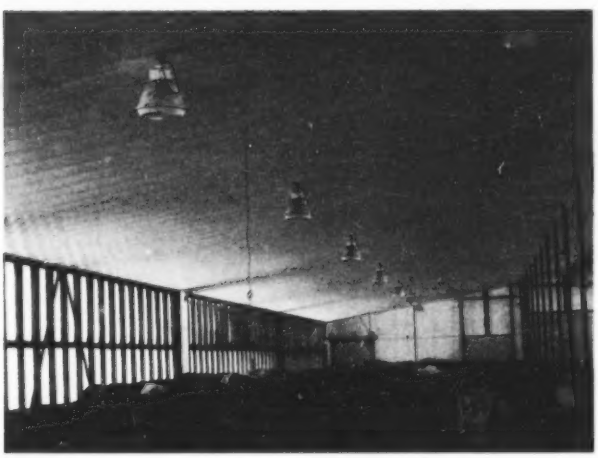

Figure 2. Uniform light levels should be maintained in areas where the cows are active.

SHORT-DAY PHOTOPERIOD FOR DRY COWS

A short-day photoperiod (SDPP) is most appropriate for dry cows. Cows that are continually exposed to LDPPs will gradually lose their ability to increase milk production during the long days. Short days appear to "reset" the cow's ability to respond to a long-day photoperiod in the next lactation. This means dry cows should not have the same lighting as lactating cows. Limiting light exposure of the dry cows to less than 12 hours each day allows their internal clock to reset, ensuring that during their next lactation a long-day photoperiod can again affect milk yield.

Perhaps of greater interest to dry cow management are the apparent effects of SDPP on udder health and disease resistance. Preliminary laboratory studies suggest that cows exposed to SDPP when dry are more able to resist a new infection.

The response to an SDPP in the dry period is consistent with the effects of calving season on milk yield. Cows calving in late winter in the northern hemisphere produce more milk than do those that calve in the summer. Prolactin (PRL) secretion may also play a role in the observed effects. The effects of the environment on PRL secretion and sensitivity during the dry period dramatically influence subsequent milk yield. Physiologically, we would expect that during the winter, dry cows would experience the lowest concentrations of PRL because of short days and low temperatures. During the summer, dry cows would experience elevated PRL secretion because of high ambient temperatures and long days. This PRL effect is a likely factor in explaining the advantage of including an SDPP between LDPPs.

LDPP VERSUS SDPP FOR MILKING AND DRY COWS

A clear challenge emerges when considering the lighting needs for milking and dry cows — if milking cows need an LDPP and dry cows need an SDPP, they cannot both be housed in the same barn. Milking cows can continue to be housed in a well-lit, naturally ventilated barn with supplemental lighting, but dry cows will need a barn that can be darkened. Since light levels cannot be reduced in a naturally ventilated barn, dry cows will require separate housing with fan ventilation.

MODIFICATIONS FOR SDPP

Poultry producers use a variety of light-blocking techniques for ventilation that can also be applied to dry cow housing. Canada Plan Service Leaflet M-5911 (Bird and Masse) describes ventilation designs with light blocks for poultry. A number of commercial air-blocking devices are also available for fans and inlets (see Figure 3). Designs using adjustable air inlets or tunnel ventilation can be used for dry cow housing. It may be most practical to house dry cows in existing two-storey barns if available. These barns may be already dark to start with and will require modifications to windows, air inlets and exhaust fans. The question becomes, "How practical is it to make a barn totally dark?"

Barns will need to be assessed on an individual basis.

Figure 3. Light-blocking fan cover.

DESIGN REQUIREMENT SUMMARY

In summary, to implement long and short photoperiod adjustments, the following design requirements should be adhered to:

- Milking cows require light levels of 15–20 footcandles for 16–18 hours per day followed by a dark period of 6–8 hours per day.
- Light levels should be as uniform as possible throughout the barn when measured at cow level.
- Dry cows should have a dark period of at least 12 hours per day.

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